HELUKABEL®

»WHITE PAPER

THE CONCEPT OF EARTHING / ELECTROMAGNETIC COMPATIBILITY (EMC) IN INDUSTRIAL PLANT DESIGN

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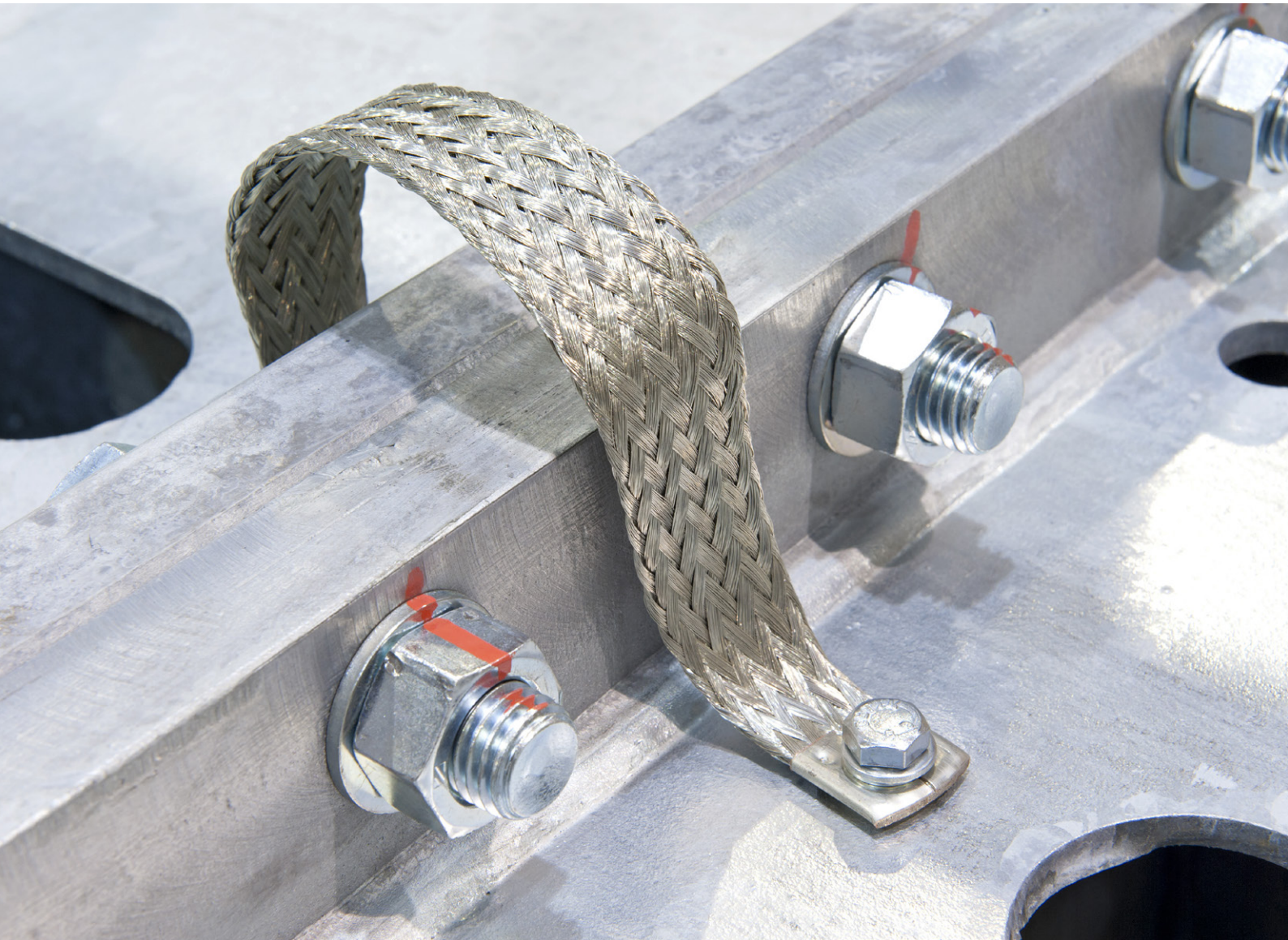
A Challenge for Industrial Automation

Faults, error messages or machine outages: these are some of the problems caused by Ethernet and bus data transmission networks in production plants. But what is the origin of network communication errors? Users often blame the performance of the cables and wires. This white paper explains why this is too narrow a view on the matter, and why inadequate electromagnetic compatibility (EMC) in plants can result in data transmission errors.



Possible Causes of Plant Failure

There are a number of factors that are likely to cause disruptions in plants: the failure to follow wiring instructions during the construction of cable ducts, the use of excess cable lengths, the incorrect selection of cable types and/or connectors, the installation of too many connectors and the presence of magnetic fields. The latter is a risk to plant disruption when the concept of earthing is not implemented in an optimum way. It is, therefore, particularly important that plant operators apply earthing concepts that not only are correct but, even more significantly, that are tailored to their needs. With this, disruptions, outages and lost sales due to inadequate electromagnetic compatibility of an entire plant can become a thing of the past.

More Power and Higher Frequencies in Smaller Spaces

In the early 2000s, electromagnetic compatibility was rarely an issue in plant machinery. Production facilities were often located in huge factories where individual machines and robots had plenty of space and operated at large distances from each other. The flow of data was easily controlled, reducing disruptions related to inadequate electromagnetic compatibility.

Today's plants are designed to be more compact and efficient. Time and space savings are important to companies as both have major impacts on costs and profits. Modern, high-performance industrial robots are now located close to each other and work more quickly, precisely and efficiently than ever before. Moreover, their tasks are becoming increasingly complex and extensive. To do their work properly, today's robots require more data and higher transmission speeds. This data increase, in turn, requires wider and higher frequency bands. The resulting magnetic fields inevitably induce noise currents and voltages. Whereas bus lines used to operate in the 500 kilohertz to 16 megahertz frequency band, industrial Ethernet uses frequencies ranging from 1 to 600 megahertz, depending on the category. Even frequencies as high as 4 gigahertz can be used these days for Single Pair Ethernet (with MultiGig BASE-T1). As a general rule of thumb, the higher the usable frequency range of a cable, the more susceptible a plant is to electromagnetic interference and hence the better the shielding must be.

However, the more complex the cable's shielding, the more inflexible, expensive and thicker its construction becomes. The same also applies to the downstream assembly processes, such as connecting the cable to the plug. The solution is therefore to minimise magnetic fields from the outset and to protect the cables from these fields. But how? The answer is the implementation of the correct earthing concept which includes earthing straps, EMC glands, stranded conductors (class 2 or 5) and high-grade shielded cables.

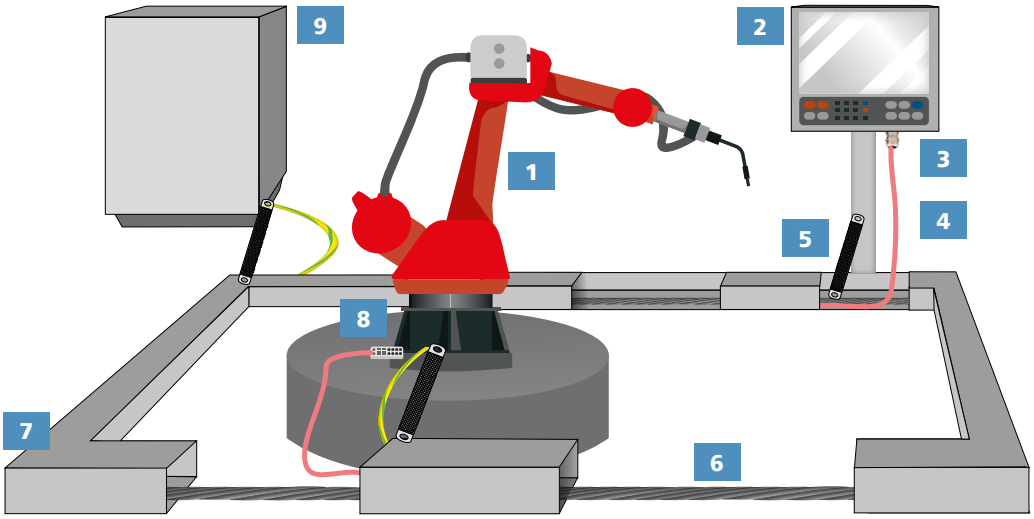
A Summary of the Effects on Machine Operation

- New, state-of-the-art plants operate with larger volumes of data, higher acceleration values and faster rates of travel. Faster data transmission requires more power.
- More power and faster rates of travel mean the drives need to be more performant and draw more current.
- Higher currents, in turn, increase the electromagnetic radiation released into the environment.
- The closer machinery and robots are to each other, the greater the radiation because distance is also an influencing factor in electromagnetic interference. Hence, magnetic field interference can be reduced by increasing the separation distances.

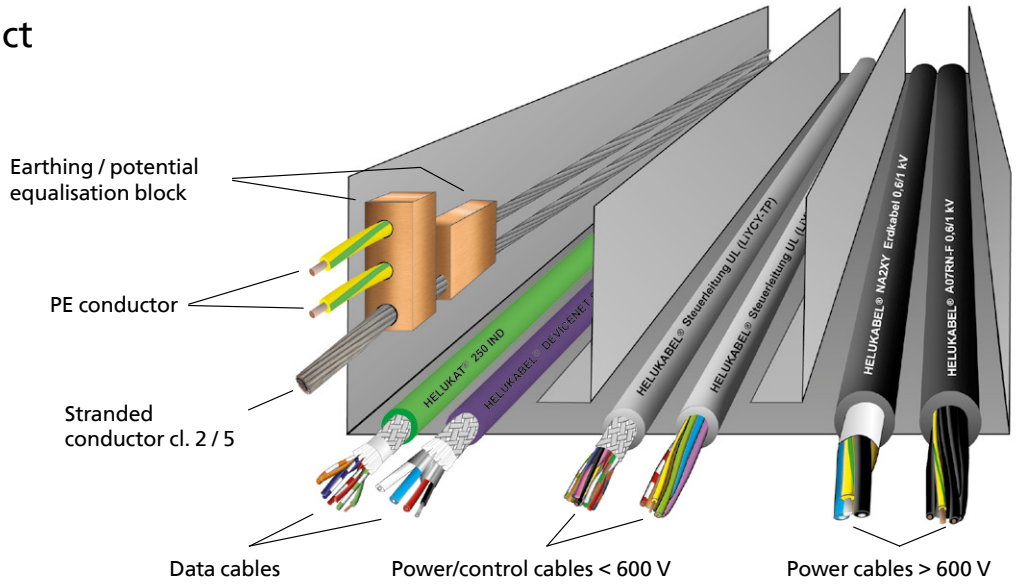
Example of a Plant Earthing Concept

The stranded conductor (6) is laid in the cable duct (7) and connected to all conducting plant sections to provide potential equalisation and prevent magnetic field interference from the outset. The diagram shows the switching cabinet (9), robot (1) and control panel (2) connected together by a copper earthing strap (5). Thanks to its enlarged contact surface, the EMC gland (3) improves conductivity between the cable shield and the cable gland on the housing. The diagram also shows the use of H07V-K/07V-K single core cables (4) and PROFInet devices (8) for earthing each individual plant component. It is up to the plant engineer to decide, on an application-by-application basis, whether green/yellow (protective earthing) or pink (functional earthing / FE) cables are used as per DIN EN 60445.

1. Robot
2. Control panel
3. EMC cable gland
4. H07V-K / 07V-K
5. Copper earthing strap
6. Tinned stranded conductor
7. Cable duct
8. PROFInet device
9. Switching cabinet



Inside the Cable Duct



So-called copper earthing straps are attached to the machinery by installers. For optimal protection against electromagnetic interference, we also recommend installing a stranded conductor (class 2 or 5) in the cable duct together with an earthing / potential equalisation block. The stranded conductor acts as an antenna and dissipates most of the electromagnetic radiation so that only a fraction of it reaches the data cables. The radiation that does reach them is then fully attenuated by the cable shields and the end result is error-free data transmission. Another benefit of our concept is the freedom it gives plant operators to upgrade their current cable ducts in a simple manner as and when required.

HELUKABEL Accessories Stop Electromagnetic Interference

The earthing concept for a plant must be considered and implemented correctly from the outset. Only in this way can persistent communication errors and machine downtime caused by electromagnetic interference be avoided. Fully compatible earthing concepts are imperative, especially in the automotive industry, robotic plants and in switching cabinets. We have the perfect "problem solvers" at your disposal.
Find out more here:
https://www.helukabel.de/de-en/Newsroom/Item/Item_192.html
Download the flyer:
https://oxomi.com/p/2024602/catalog/10249124

Copper earthing strap: the earthing strap with its rounded contacts comprises a mesh of thin, tinned copper wire and is for the dispersion of electromagnetic currents. It can be used at temperatures from minus 20 degrees Celsius to plus 125 degrees Celsius. The contact surfaces comprise seamless pressed ferrules and the individual wire thickness is 0.2 millimetres. Earthing straps are mainly used in the automotive industry, robotic plants and in switching cabinets.

Glands: thanks to their enlarged contact surfaces, EMC cable and earthing glands improve conductivity between the cable shield and the cable gland on the housing (protection class IP 68 - 5 bar).
HELUTOP® MS-EP/MS-EP4: the nickel-plated brass glands with their copper beryllium contact system and polyamide PA 6 terminal inserts ensure excellent shielding attenuation and current dissipation. Contact is made automatically when the gland is tightened, and when the clamp plates ensure perfect strain relief. The moving ring in the contact system saves time, reduces assembly costs and allows for optimal handling.

Stranded conductor (class 2 or 5): the tinned stranded conductor is used for earthing purposes in plants and machinery. It is installed in the cable duct alongside the earthing / potential equalisation blocks, connecting terminals or clamping springs, and is mainly used in the automotive industry, robotic plants and in switching cabinets.

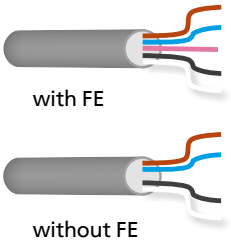
Class 2 = tinned multi-stranded copper conductor as per DIN VDE 0295

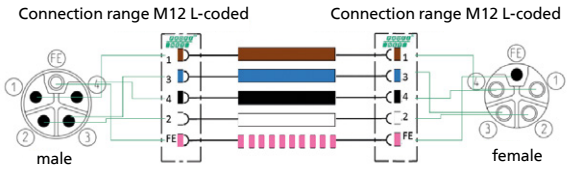
Class 5 = tinned finely-stranded copper wire as per DIN VDE 0295

HELUKABEL® PROFINET CONNECTION CABLES (POWER)

OEM-listed

Our bus and data cables with (pink) and without functional earthing (FE) round off the assortment and ensure optimal data transmission in industrial plants.





HELUCONTROL® PROFINET, 24 V POWER PVC /+ FE PVC

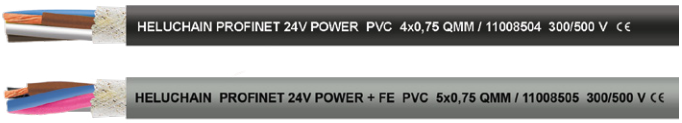
PVC PROFINET-connection cable

Applications

- For medium mechanical stress in flexible applications with free movement without tensile load and without forced guidance in dry, damp and wet rooms (not applicable outside)
- For the supply of power to PROFInet components in machine tools, conveyor belts, assembly lines and in plant construction

HELUCHAIN® PROFINET, 24 V POWER PVC /+ FE PVC

PROFINET-compliant, highly flexible
PVC drag chain cable



Applications

- In dry or damp rooms (not applicable outside)
- In measurement and control equipment with frequent lifting and bending stresses in the automotive industry
- In machinery and tool construction
- For permanently moving machine parts

HELUKABEL® INDUSTRIAL ETHERNET – BUS-CABLE

Part no. 800653

Part no. 800654

Part no. 802914 / 800655

Part no. 11007800

Part no. 82839

Part no. 801197

Part no. 805684

Part no. 802184

Part no. 80267

Part no. 81911

» CONTACT

Do you have questions about our earthing products or
are you looking for high-grade shielded data cables for your plant?
If yes, please get in touch with us. We are happy to help!

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